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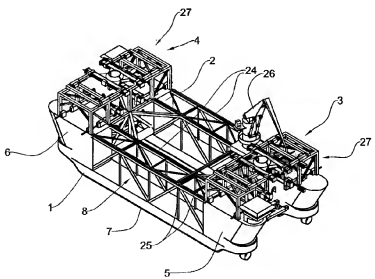
(54) **Title:** VESSEL FOR INSTALLATION OF ERECT STRUCTURES



(57) **Abstract:** Vessel and method for transportation of erect structures to an offshore field and for installation of the erect structures (65, 73, 80) on the sea bottom. The vessel has gripping means (36, 52) for gripping and holding at least one erect structure (65, 73, 80) in a substantially upright position, and lifting means (51, 71) for lifting the erect structure and lowering the erect structure (65, 73, 80) to the seabed. The method provides picking up the erect structure (65, 73, 80) by lifting it vertically from the seabed by means of the lifting means (51, 71), transporting the erect structure (65, 73, 80) in the lifted erect position to the offshore field, installing the erect structure (65, 73, 80) by lowering it to the seabed.

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Vessel for installation of erect structures

The present invention relates to an installation vessel for installation of longitudinal erect objects offshore, in particular, but not exclusive, for installation of offshore wind turbines as one unit. The invention also relates to a method for performing the above installation.

Presently two principal methods are used for raising longitudinal erect structures offshore.

The first method is to build the structure on site from modules or components that are transported to the site and mounted according to the building sequence. The disadvantages of this method are that it involves several vessels, a large number of personnel, takes a long time and is expensive. Furthermore the weather is critical, as work cannot be done at sea in rough weather.

The second method is to transport the structure in pieces either lying or standing upright on a barge or the like. On site the structure is erected (if lying on the deck of the barge), hoisted from the barge and lowered to the sea bottom. The disadvantages of this method is that it involves several vessels, since often at least two crane-ships must be employed for the task in addition to the barge, the weather is critical, since the hoisting operation will require calm sea, and the method involves a large number of personnel.

The present invention has as its main objective to provide a novel method that will eliminate or at least substantially decrease one or more of the disadvantages of the previously known methods.

A further objective of the present invention is to enable the installation in as few as possible operations offshore, and more specifically, the vessel according to the invention shall be capable of installing foundations, towers, nacelles and blades of wind turbines up to at least 5 MW machines as one unit.

The present invention provides for a vessel and a method that is feasible and efficient for safe, environmentally friendly and cost-effective installation of wind turbines as one unit. The vessel is in one embodiment capable of transporting 2 wind turbines at the same time with a dry weight of 2500 tonnes each. The water depth at the place of installation may vary between 4 and 20 meters. Overall length of the vessel is 100 meter and the total width is 42 meter.

The vessel according to one embodiment of the invention is capable of transporting and installing two wind turbines, with a tower height of 100 m, rotor diameter of 100 m and a total weight for each wind turbine (tower, nacelle, rotor and foundation) of about 2500 tons, in shallow water (4 to 6 meters) at a maximum significant wave height of 0.5 meter. In areas where the water depth is above 6 meters, the vessel is designed for significant wave heights of 2.0 meters and wave periods between 3 and 13 seconds.

The invention will be explained in more detail in the following by a preferred example embodiment, referring to the accompanying drawings, in which:

figure 1 shows a vessel according to an embodiment of the present invention,

figure 2 shows a detail of the vessel of figure 1,

figure 3 shows the vessel of figure 1 in side view elevation,

figure 4 shows the vessel of figure 1 in plan view,

figure 5 shows the vessel in front view elevation,

figures 6 – 15 show the vessel picking up two wind turbines erected at the wharfside:

figures 16 – 19 show the vessel installing two wind turbines offshore:

figure 20 shows a piled foundation, as an alternative to the gravitational foundation, being installed.

A vessel 1 according to a preferred embodiment of the present invention is shown in figure 1. The vessel is of a double hull construction having a first hull 1 and a second hull 2. The two hulls are interconnected by a first end framework, generally denoted by 3, at the bow and a second framework, generally denoted by 4, at the stern. To save weight and reduce wind and wave forces on the vessel, the middle part of each hull 1, 2 is reduced in height, leaving only a short portion 5 at the bow and a short portion 6 at the stern in full height, while a pontoon part (the part having buoyancy) of a central portion 7 of the hull has a height, which is only about a fourth of the full hull height. To stiffen the hull a central framework, generally denoted by 8, bridges between the bow portion 5 and the stern portion 5. The framework 8 is also connected to the central hull portion 7.

The vessel will now be described in more detail with reference to figures 2, 3, 4 and 5, in which figure 2 shows a detail at one end of the vessel, figure 3 shows the vessel in side view, figure 4 shows the vessel in plan view and figure 5 shows the vessel in front view.

As seen in figure 3, each hull 1, 2 (only the first hull 1 is visible in figure 3) generally consists of the bow portion 5, the stern portion 6, the central portion 7 and the framework 8. The framework 8 is build up by two parallel horizontal girders, an outer girder 9 and an inner girder 10 (se also figure 4), which has approximately the same mutual distance as the width of the hull 1, vertical posts 11, which extend downward from each girder 9, 10 to the central hull portion 7, oblique stays 12, which also extend from the girders 9, 10 to the central hull portion 7, and stays 13 and 14, which extend in right angle between the girders 9, 10 and in an oblique angel between the girders 9, 10, respectively.

On top of the girders 9, 10 a first set of rails 24 are mounted. Alternatively, the rails 24 may be integrated in the girders 9, 10. Transverse to the rails 24 a second set of rails 25 are mounted to be slidably moveable along the rails 24. On top of the second rails 25 a crane 26 is slidably mounted. The crane 26 may be of any conventional jib type currently used on offshore service vessels. The crane 26 may be replaced or supplemented by a drilling unit, e.g., for installation of monopiles.

Although, in the above and in the following, the vessel is said to have a bow and stern, the embodiment shown in the accompanying drawings actually has two bows. When, for the purpose of this description a distinction between bow and stern is made, this is purely for practical reasons, to make it easier to understand which end of the vessel is in question.

Each hull 1, 2 has a bow shape both at the bow part 5 and the stern part 6 as well as a propulsion propeller or thruster 15. Each hull 1, 2 has only one bridge 16, 17, however, the hulls 1, 2 are oriented so that the bridges 16, 17 are situated on opposite ends of the vessel. The hulls 1, 2 are virtually identical.

The hulls 1, 2 are interconnected by the frameworks 3 and 4. The frameworks 3 and 4 are in principle identical and framework 3 will be described only. The framework 3 consists in general of a lower stay 18 of a coarse dimension, which extend between the bow and stern hull portions 5, 6, respectively, in a level just above the central hull portion 7, a girder 19, which is also extending between the bow and stern hull portions 5, 6, respectively, just below the deck of the bow and stern hull portions, stays 20 and 21, which extend vertically and obliquely, respectively, in the vertical plane between the lower stay 18 and the girder 19, and stays 22 and 23, which extend from the girder 19 to the inner girder 10 of a respective one of the frameworks 8.

Bridging across the bow hull portions 5 and also across the stern hull portions 6 of the hulls 1, 2 are mounted a gripper framework 27. The two frameworks 27 and associated equipment for any practical purposes are identical, and only one of the frameworks 27 will be explained.

The framework 27 has a horizontal girder 28 extending from the outer side of the first hull 1 to the outer side of the second hull 2 at a vertical distance above the girder 19. The girder 28 is connected to the deck of the hulls 1 and 2 and the girder 19 via vertical stays 29. Parallel to the girder 28 and close to the end of the hulls 1 and 2 are a set of girders 30 and 31. The girders 30 and 31 extend from a respective outer side of the hulls 1, 2 towards each other and define a gap 32 thereinbetween. The girders 30 and 32 are connected to the hulls 1 and 2 by vertical stays 33. Horizontal stays 34 are extending between the girder 28 and the girders 30, 31. In addition oblique stays 35 are mounted between some of the stays and girders to further stiffen the framework 27.

Between the hulls 1, 2, delimited only by the frameworks 8 and the frameworks 3, 4, is a large moonpool 75 (see figure 4). This moonpool 75 can be serviced by the crane 26 to launch an ROV (Remotely Operated Vehicle), retrieve equipment from the sea and other operations associated with offshore operations.

On top of the framework 27 an upper gripper assembly 36 is mounted. The gripper assembly 36 consists of two grippers 37 and 38, which are mounted on top of the girders 28 and 30, 31. More specifically the gripper 37 is mounted on top of the girder 28 and the girder 30 to be slidable along the girders, and the gripper 38 is mounted on top of the girders 28 and 31 to be slidable along the girders. Each of the grippers 37 and 38 consists of a frame 39, a skid beam 40 and a grip head 41. The frame 39 is mounted in a pair of sleeves 42, which are fixedly connected to the girders 28 and 30, 31, respectively. A pair of hydraulic actuators 43 act to move the frame 39 along the girders 28 and 30, 31. The skid beam 40 is mounted in sleeves 44 fixed to the frame 39, and a pair of co-acting hydraulic actuators 45 act to skid the skid beam 40 in a direction transverse to the movement of the frame 39. The grip head 41 is fixedly mounted to the skid beam 40.

On the deck of each of the bow and stern hull portions 5, 6 is also mounted a strand support unit 46. Each of the pole support units 46 has a pair of sliders 47, which are moveable in synchronicity by a pair of hydraulic actuators 48. At the inner ends of the

sliders 47 a skid beam 49 is mounted. The skid beam 49 is slidable transverse to the sliders 47 by a pair of co-working hydraulic actuators 50. A plurality of strand jacks 51 are mounted on the skid beam 49.

In the lower part of the hulls 1, 2, below the upper gripper assembly 36, a lower gripper assembly 52 is hingedly mounted to the inside of the hulls 1, 2. The gripper assemblies 52 consist of two grippers 53, 54, which are hingedly connected to the bow or stern portions 5, 6 of the hulls 1, 2. The grippers 53, 54 can be articulated from a substantially horizontal position (as shown in figure 5) to a raised position(see figure 8) by an actuator 55, 56, respectively. At the ends of the grippers 53, 54 a gripper head 57, 58 are formed. The gripper heads being of substantially the same construction as the gripper heads 41 of the upper gripper assembly 36.

Before explaining the function of the vessel and a procedure for installing wind turbines, yet another feature of the vessel will be explained, referring to figure 17.

Figure 17 shows a part of the hull 1, wherein the bow portion 5 of the hull is omitted to better view the details that will be explained. Each hull has two spud legs 59 situated near the ends of the central portions 7. The spud leg 59 extends through a hole through the hull. Each of the spud legs 59 is actuated by a mechanism 60 comprising an hydraulic damper 61 and a pair of pre-tensioned strands 62. The damper 61 is fixedly connected to the girder 19 via two brackets 63, which extend about halfway from the girder 19 to the top of the central portion 7 of the hull. The strands 62 extend from the girder 19 to the top of the central portion 7 of the hull. The hydraulic damper is connected to a yoke 64, which in turn is connected to the spud leg 59. The yoke has strand jacks 86 integrated at opposite ends of the yoke 64 and the yoke lowered and lifted by these jacks 86. Thereby the spud leg can be extended below or retracted into the hull. The damper 61 will function to dampen the forces on the spud leg 59 when the vessel is ballasted so that the spud legs 59 contacts the seabed. The jacks 86 will also function to lock the spud leg 59 in the extended or retracted position and serve to adjust the levelling of the vessel after the vessel has settled on the seabed.

The pick-up and installation of wind turbines shall now be explained referring to figures 6 – 22.

In figure 6 the vessel is ready to pick up a wind turbine 65. The wind turbine consists generally of a tower 66, a foundation 67, a nacelle 68 and three blades 69. In the present embodiment the foundation is a gravity foundation, designed to support the tower, nacelle and blades substantially by its own weight.

The wind turbine has been build to its complete state at the quayside (the quay being shown at 70). The vessel has in figure 6 turned one of its bows towards the wind turbine 65 to pick this up.

In figure 7 the vessel has positioned itself so that the wind turbine 65 is situated between the two hull portions 5 of the hulls 1 and 2. Strands 71 are connected to the foundation 67 and are gripped at the opposite ends by the strand jacks 51.

In figure 8, which is a close-up of the foundation 67 and the lower grippers 53, 54, the wind turbine 65 has been lifted by the strand jacks 51 so that the foundation is in the vicinity of the lower grippers 53, 54.

In figure 9 the grippers 53, 54 are in the process of being lowered by the actuators 55, 56.

In figure 10 the grippers 53, 54 have gripped around the foundation at an upper circular part 72 of the foundation 67 so that the gripping heads 57, 58 hold the upper circular part 72 in a firm grip.

Figure 11 shows a section around the upper grippers 37, 38. The grippers 37, 38 are about to be displaced towards each other by actuating the actuators 43. To compensate for any misalignment the skid beams 40 can be moved transverse to the direction of movement of the grippers 37, 38 to align the grip heads 41 with the tower 66.

In figure 12 the grippers 37, 38 have been moved to full engagement with the tower 66 and hold this in a firm grip.

Figure 13 shows in full view how the wind turbine is carried by the vessel, the strands 71 providing the vertical support of the wind turbine 65 and the lower and upper grippers 53, 54, 37, 38 providing the horizontal support of the wind turbine.

After picking up the wind turbine 65 the vessel backs out from the quay, makes a turn and proceeds towards a second wind turbine 73. The second wind turbine 73 is handled in the same way as the first wind turbine 65, so that the vessel carries two wind turbines, one at both ends, as shown in figure 14.

When the vessel has reached the filed were the wind turbines are to be operating, the vessel will position itself over a hollow 74 that has been pre-dug in the sea bottom (see figure 16). The technique for digging such hollows for gravity foundations is well established and will not be explained in detail herein.

After being positioned so that the foundation 67 is directly above the hollow 74, the vessel will be ballasted to descend towards the bottom. How far the vessel will descend will depend on the depth at the location. The vessel will stop its descent at a short distance from the seabed. As shown in figure 16, the vessel will then extend the spud legs 59, as explained earlier in connection with figure 17, until they are firmly settled in the seabed. The spud legs 59 may be individually controlled to compensate for an uneven seabed. This way the vessel will actually be standing on the seabed as shown in figure 18. Optionally a mooring system can be applied in addition to or instead of a DP-system.

Then the lower grippers 53, 54 will be opened. The position of the wind turbine 65 relative to the hollow 74 may then be adjusted. This is done by skidding the skid beams 40 and 49 to move the wind turbine longitudinally relative to the vessel, and by moving the grippers 37, 38 in the same direction, as well as simultaneously moving the sliders 47 in the same direction, to move the wind turbine 65 transverse to the vessel.

The upper grippers 37, 38 will then be opened, but only as far as to allow a small clearance to the tower 66 and still giving lateral support. As shown in figure 19 the wind turbine 65 is then lowered down into the hollow 74 by actuating the strand jacks 51 to give out strand 71.

When the foundation 67 has settled on the seabed the strands 71 are released from the foundation 67. This may be performed by divers or a disconnection tool, or it may be remotely operated from the vessel. Thereafter the upper grippers 37, 38 are fully opened to release the tower 66.

When the first wind turbine is installed in the above-explained manner, the vessel will be ballasted to rise in the water, retract its spud legs 59 and move away from the wind turbine. The other turbine 73 is then installed in the same way as the first wind turbine 65, which process will not be explained in detail.

Figure 20 shows an alternative type of foundation 76 and an associated installation method. The foundation 76 is of a starfish type having a plurality of legs 77 (in the shown embodiment five legs 77) extending laterally out from the base of the foundation. At the outer end of each leg 77 is a through hole 78 for insertion of a pile 79.

The process for picking up the wind turbine 80 with the foundation 76 is the same as for a gravity foundation 67. The positioning and lowering of the wind turbine 80 is also essentially the same as for the wind turbine 65. However, the wind turbine 80 with the starfish foundation 76 is due to its lower weight preferably guided by both the upper grippers 37, 38 and the lower grippers 53, 54 during the lowering to the seabed.

Piles 79 are held in pile holders 81, mounted on the side of the hull 1, 2 and the framework 27. The piles may be lifted by the crane 26 when the foundation 76 is positioned on the seabed to be piled to the seabed. Another pile holder 82 is arranged around the tower 83 of the wind turbine 80 approximately midway between the

foundation 76 and the upper grippers 37, 38. This holder 82 has two arms 84 (only one visible in figure 20) with a through hole 85 at the outer end thereof, the through holes 85 being situated directly above a respective one of two holes 78 in the legs 77. Two piles are supported by the pile holder 82 during transportation of the wind turbine 65.

As can be seen from figure 20, one of the strands 71 extends through one of the lower grippers 54. This gripper 54 has a slit 87 at its outer end so that as the gripper 54 is lifted, the strand 71 may slip through the slit 87.

When the foundation 76 has been lowered to the seabed in substantially the same way as described above for the foundation 65 the pile holder 82 is removed and the foundation is now ready for piling. The crane 26 lifts a pile hammer 86 and places it on top of one of the piles 79. The pile hammer 86 is then actuated and drives the pile 79 into the seabed.

When the pile has been driven sufficiently far down into the seabed the crane 26 then lifts another pile and inserts this into the hole 78 of another one of the legs 77. This is repeated until the foundation 76 is thoroughly fastened to the seabed. The vessel is then ballasted and moved away from the wind turbine 80 as explained previously.

Although specific embodiments have been described in the above several modifications can be made without effecting on the performance of the invention. Number and capacity of strand jacks can be varied to fit requirements from the wind turbine foundations. However, a minimum of four lifting points is preferable. The piles may be stored in pile holders as described above or preinstalled at the foundation itself.

Patent Claims

1.

Vessel for transportation of erect structures to an offshore field and for installation of the erect structures (65, 73, 80) on the sea bottom, characterised in that the vessel having gripping means (36, 52) for gripping and holding at least one erect structure (65, 73, 80) in a substantially upright position, and that the vessel having lifting means (51, 71) for lifting the erect structure (65, 73, 80) and lowering the erect structure (65, 73, 80) to the seabed.

2.

Vessel according to claim 1, characterised in that said vessel having two hulls (1, 2), which hulls are defining a gap (32) thereinbetween.

3.

Vessel according to claim 2, characterised in that the gripping means (36, 52) are arranged to grip the erect structure (65, 73, 80) in the gap (32), close to one end of the vessel.

4.

Vessel according to claim 3, characterised in the gripping means comprising a lower gripper assembly (52) and an upper gripper assembly (36).

5.

Vessel according to claim 4, characterised in that the gripper assemblies (36, 52) comprising gripping heads (41, 53, 54) which are moveable into and out of the gap (32), which gripping heads (41, 53, 54) are adapted to the shape of the erect structure (65, 73, 80).

6.

Vessel according to claim 5, characterised in that the lower gripper assembly (52) comprising two grippers (53, 54), which are articulately coupled to a

respective of the hulls (1, 2), the grippers (53, 54) being designed to grip a portion (72) of the erect structure (65, 73, 80) when they are in a first position and releasing the erect structure (65, 73, 80) when they are in a second position.

7.

Vessel according to claim 6, characterised in that the second position is a raised position.

8.

Vessel according to any of the claims 4 – 7, characterised in that the upper gripper assembly (36) comprising two grippers (37, 38), which are moveable into and out of the gap (32) to grip a portion of the erect structure (65, 73, 80).

9.

Vessel according to claim 8, characterised in that the gripping head (41) of each gripper (37, 38) is mounted moveable in a direction generally transverse to the direction of movement of the gripper (37, 38).

10.

Vessel according to claim 9, characterised in that the gripping head is connected to a skid beam (40) on the gripper (37, 38).

11.

Vessel according to any of the claims 8 – 10, characterised in that the grippers (37, 38) are slidably mounted on a gripper framework (27) bridging the two hulls (1, 2).

12.

Vessel according to any of the preceding claims, characterised in that the lifting means (51, 71) comprising strand jacks (51) and strands (71), the strands (71) being adapted for connection to a lower part of the erect structure (65, 73, 80) and the strand jacks (51) being arranged on the vessel.

13.

Vessel according to claim 12, c h a r a c t e r i s e d i n that the strand jacks (51) are moveably mounted on the vessel.

14.

Vessel according to claim 13, c h a r a c t e r i s e d i n that the strand jacks (51) are mounted on a skid beam (49), which in turn is coupled to at least one slider (47), the skid beam (49) being moveable generally transverse to a direction of movement of the slider (47).

15.

Vessel according to any of the preceding claims 2 – 14, c h a r a c t e r i s e d i n that each of the hulls (1, 2) comprising a central portion (7) and two end portions (5, 6), the central portion (7) having a pontoon part having a substantially lower height than the end portions (5, 6), the central portion further having a central framework (8) above the pontoon part, the central framework (8) extending between the end portions (5, 6).

16.

Vessel according to claim 15, c h a r a c t e r i s e d i n that the end portions (5, 6) of the respective hulls (1, 2) are interconnected by a first and second end framework (3, 4), a moonpool (75) being defined between the end frameworks (3, 4) and the central frameworks (8).

17.

Vessel according to claim 15 or 16, c h a r a c t e r i s e d i n that a first set of rails (24) for at least one crane (26) are arranged on top of or integrated in the central framework (8).

18.

Vessel according to claim 17, c h a r a c t e r i s e d i n that a second set of rails (25) are arranged on top of the first set of rails, the second set of rails (25) being

moveable generally transverse to the extent of the first set of rails (24), the crane being arranged moveable on the second set of rails (25) in a direction generally transverse to the direction of movement of the second set of rails (25).

19.

Vessel according to any of the preceding claims, characterised in that it further comprises means for piling the erect structure to the seabed.

20.

Vessel according to claim 19, characterised in that the means for piling comprising a piling hammer (86), which is adapted to be suspended in a crane (26) and at least one elongate pile (79), that is adapted to be inserted through an opening (78) in a foundation (76) of the erect structure.

21.

Vessel according to claims 19 or 20, characterised in that it further comprises a holder (81) for piles (79), to store the piles (79) in an upright position close to the gripping means (36, 52).

22.

Vessel according to any of the preceding claims, characterised in that it further comprises ballasting means to lower the vessel relative to the water surface during picking up and/or installing the erect structure.

23.

Vessel according to any of the preceding claims, characterised in that it further comprises spud legs (59) for extension beyond the bottom of the vessel, the spud legs (59) being adapted for contact with the seabed during picking up and/or installation of the erect structure.

24.

Vessel according to any of the preceding claims, c h a r a c t e r i s e d i n that the vessel having a bow at each end.

25.

Method for transportation of erect structures to an offshore field and for installation of the erect structures (65, 73, 80) on the sea bottom, c h a r a c t e r i s e d i n providing at least one erect structure (65, 73, 80) standing in an upright position on an underwater surface close to the shore, picking up the erect structure (65, 73, 80) by lifting it vertically from the seabed by means of a lifting means (51, 71) on a vessel, transporting the erect structure (65, 73, 80) in the lifted erect position to the offshore field by means of the vessel, installing the erect structure (65, 73, 80) by lowering it to the seabed by means of the lifting means (51, 71).

26.

Method according to claim 23, c h a r a c t e r i s e d i n laterally stabilising the erect structure during transport by means of gripping means (36, 52).

27.

Method according to claim 23 or 24, c h a r a c t e r i s e d i n suspending one erect structure (65, 73, 80) at each end of the vessel.

28.

Method according to any of the preceding claims 25 – 27, c h a r a c t e r i s e d i n settling the vessel on the seabed during picking up and/or installation.

29.

Method according to claim 28, c h a r a c t e r i s e d i n lowering the vessel by ballasting.

30.

Method according to claim 28, c h a r a c t e r i s e d i n lowering spud legs (59) to make contact with the seabed.

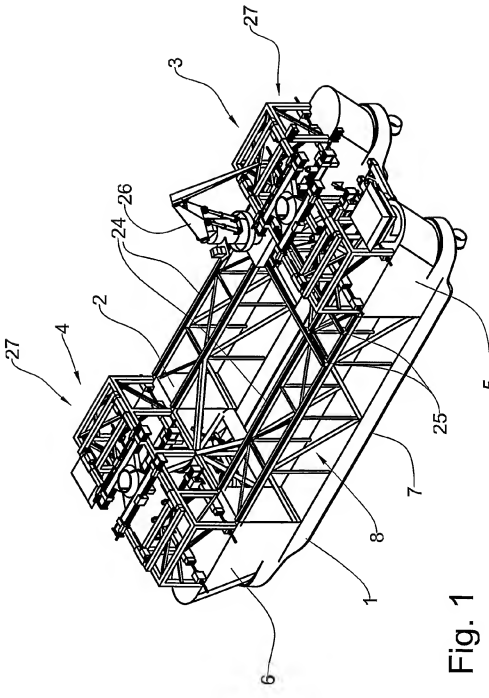

Fig. 1

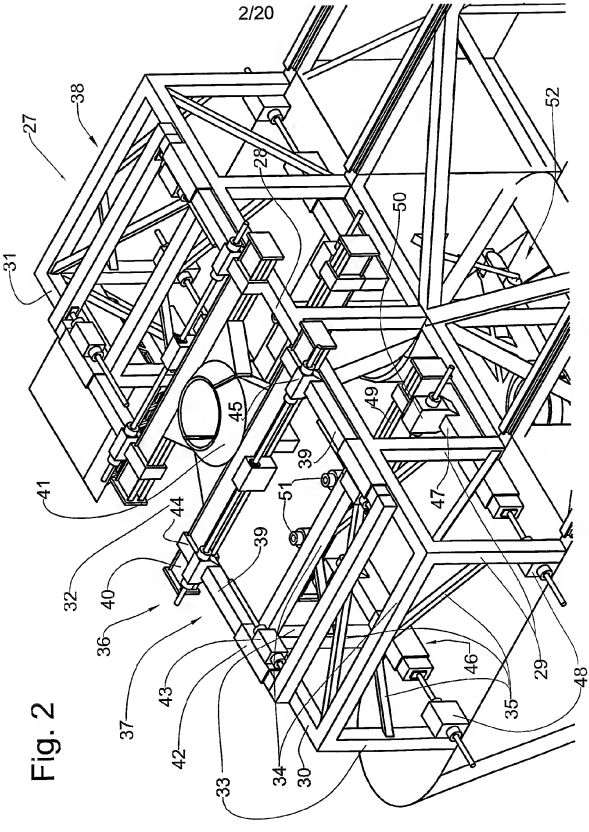
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Fig. 2

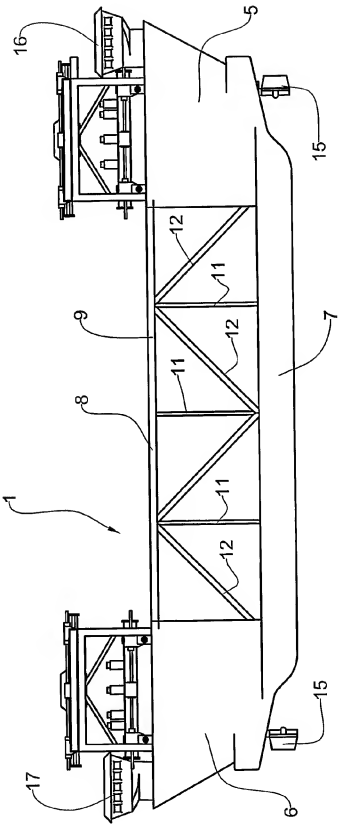


Fig. 3

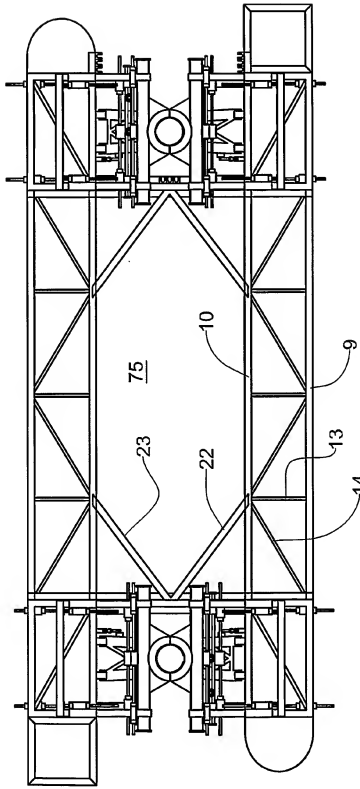


Fig. 4

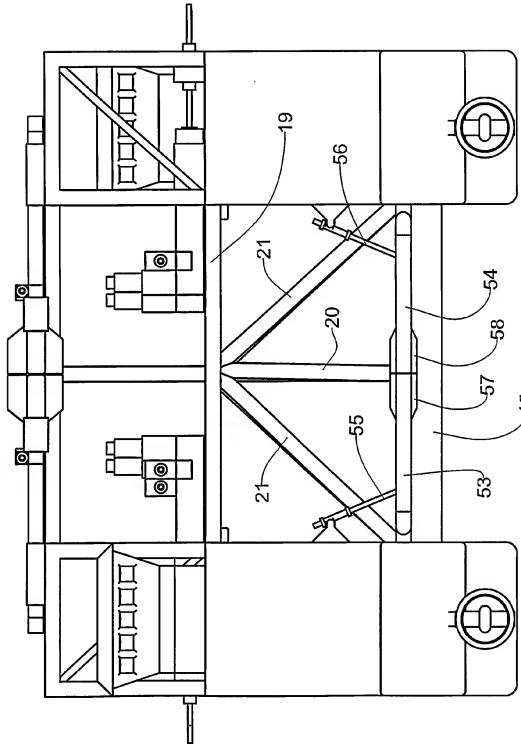


Fig. 5

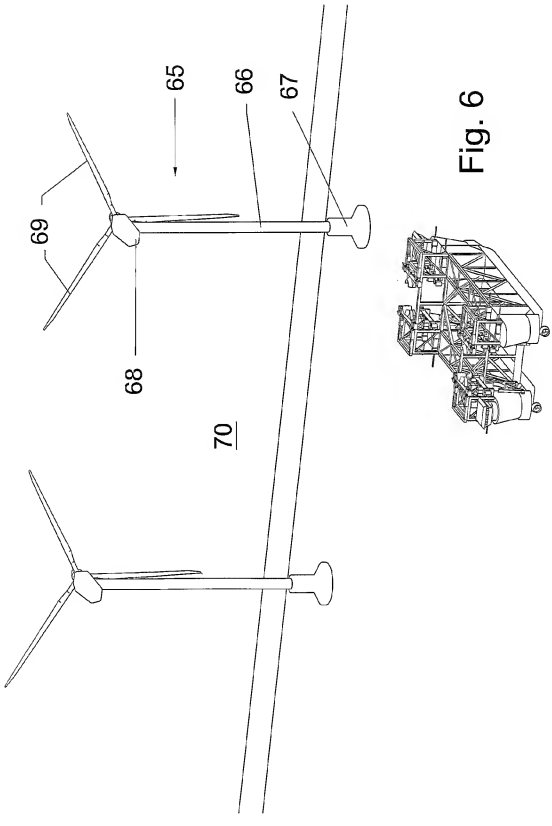
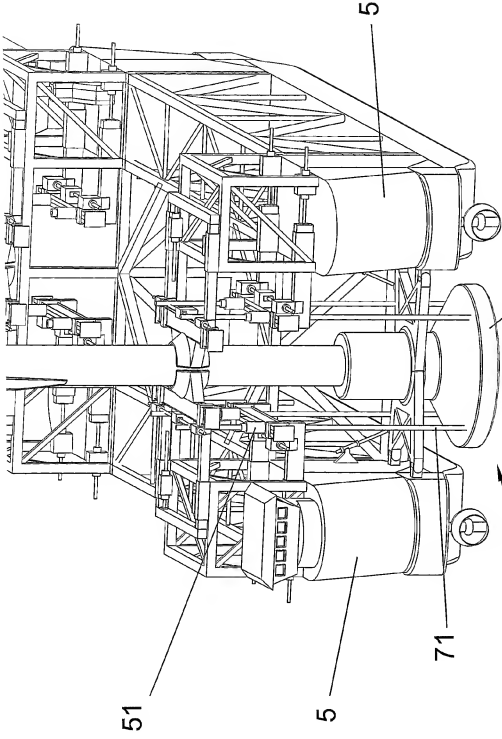


Fig. 6



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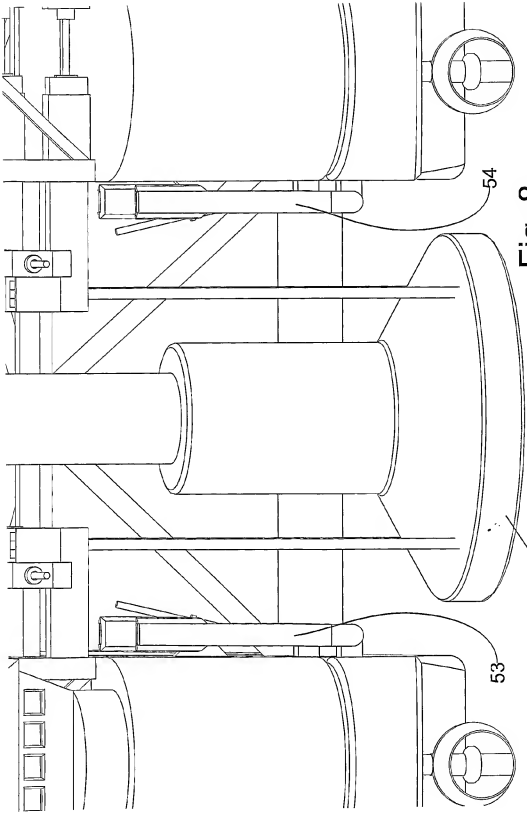

Fig. 8

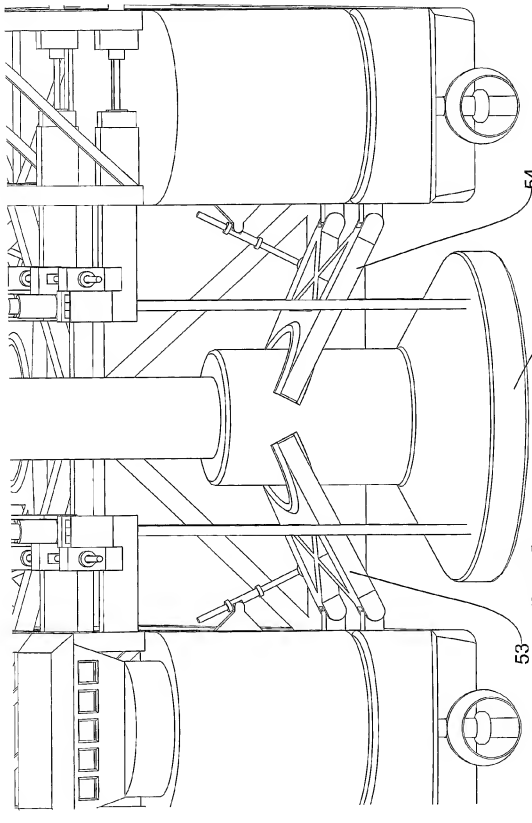

Fig. 9

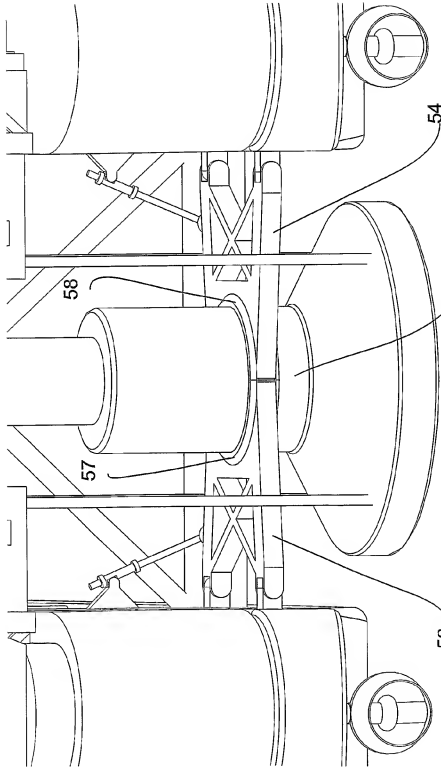

Fig. 10

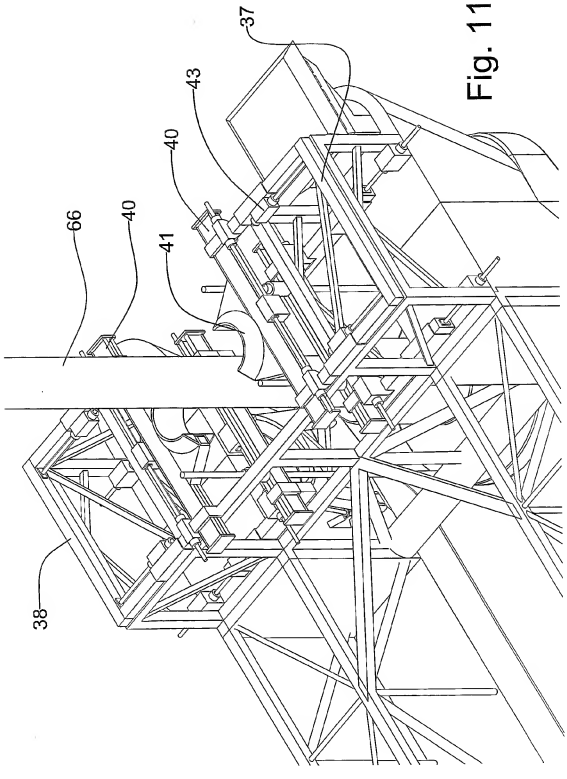

Fig. 11

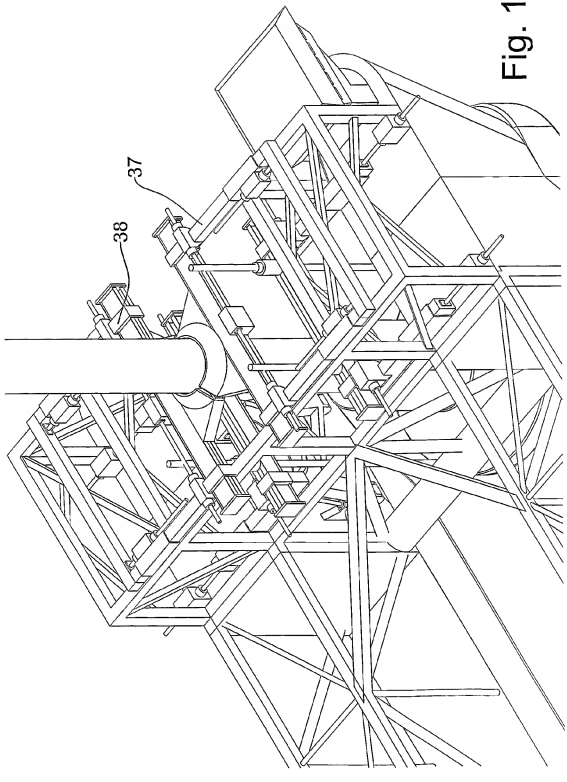

Fig. 12

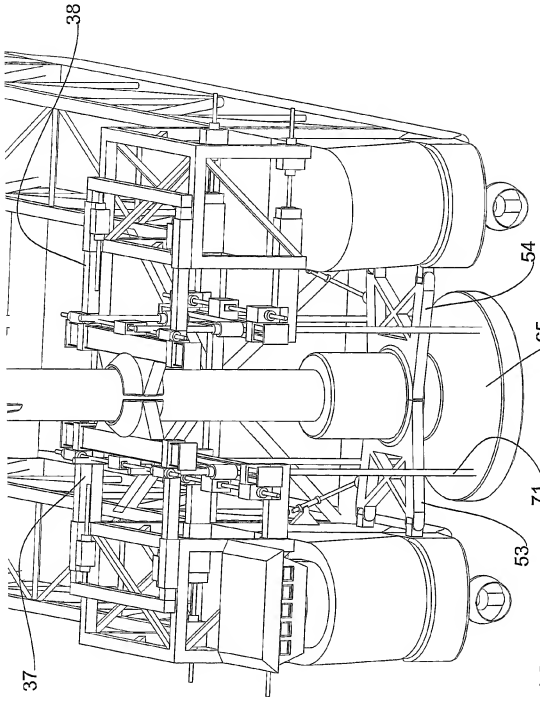

Fig. 13

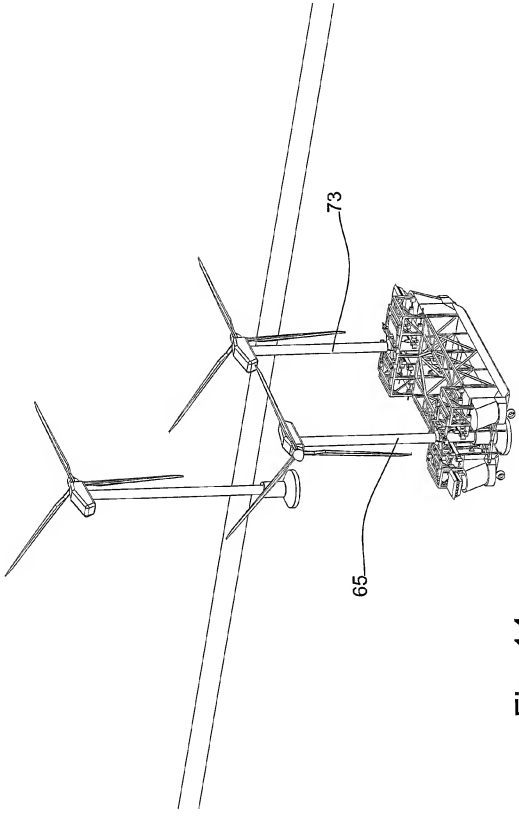

Fig. 14

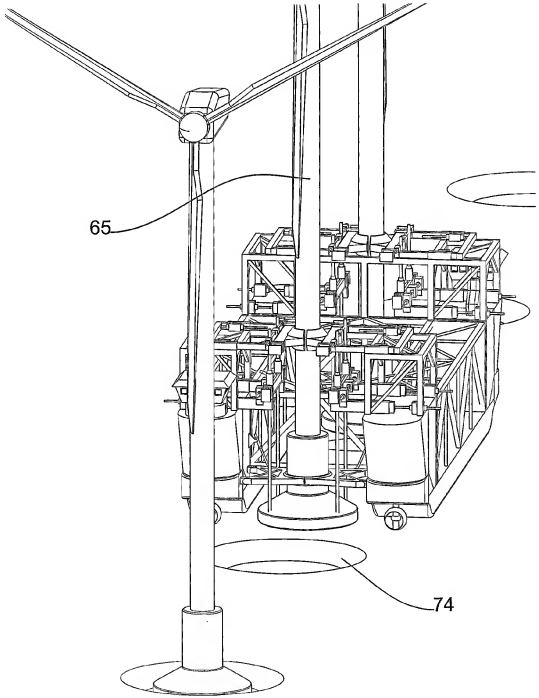

Fig. 15

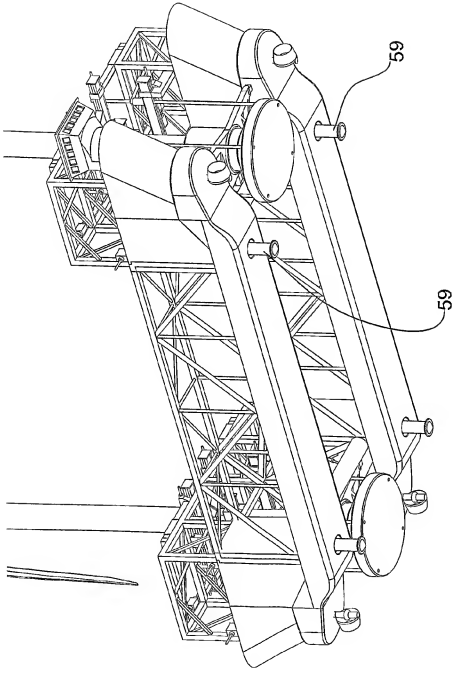

Fig. 16

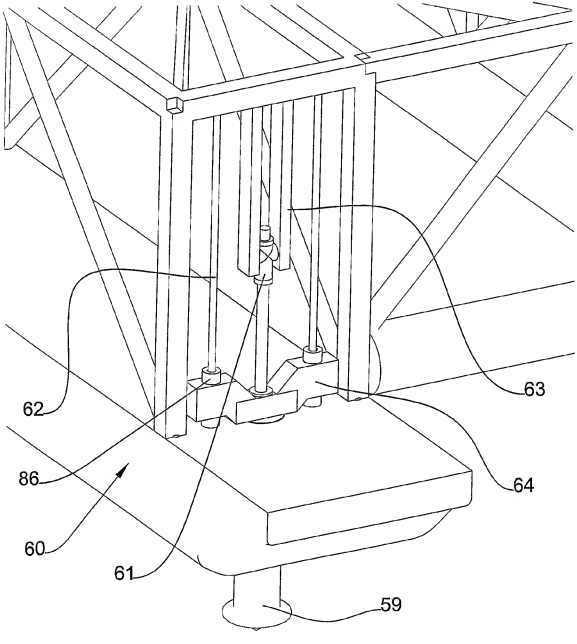

Fig. 17

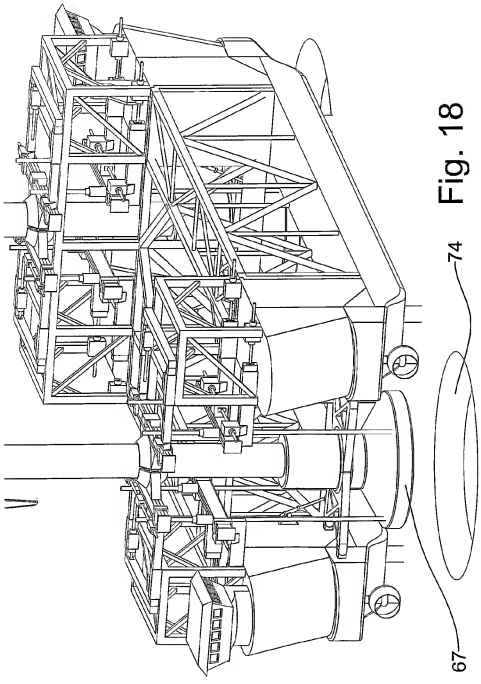

Fig. 18

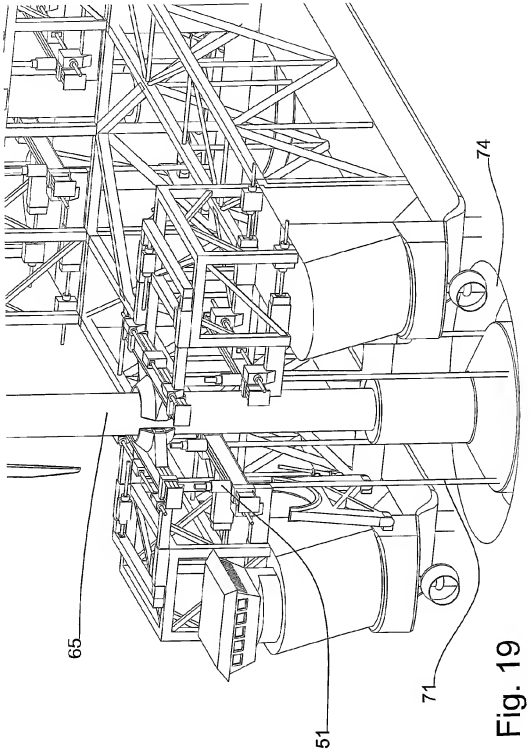

Fig. 19

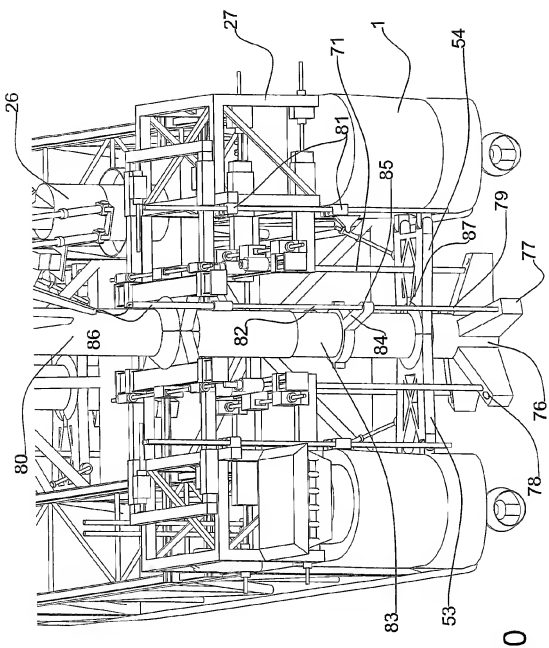

Fig. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00056

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B63B 35/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B63B, E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20010086 U1 (KUSAN, ANDRE), 28 December 2000 (28.12.00)	1,2,25,26
A		3-24,27-30
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E,X	NL 1016859 A (MARINE CONSTRUCT B V), 1 August 2002 (01.08.02), figures 4-6	1,25,26
A		2-24,27-30
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2002	25 NOV 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Douglas Elliot/EK Telephone No. +46 8 782 25 00

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CORRECTED

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/09/02

International application No.
PCT/NO 02/00056

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 20010086 U1	28/12/00	NONE	
NL 1016859 A	01/08/02	WO 0248547 A	20/06/02